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June 20, 1985

Mr. Al Randol
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Mass.
02254-9149

Dear Al:

Please find enclosed two copies of the interim report for the Acushnet Estuary New Bedford Superfund Project. If you have any questions, please call.

We should be thinking of initiating the summer work very soon (next week or two). If we wait much longer, the proposed bird work will be more difficult because of fledgling birds. Also changes in standing crop of vegetation (primary productivity) will be difficult to measure toward the end of summer.

Cordially,

Gary R. Sanford

Gary R. Sanford, Ph.D.

BIOLOGICAL STUDIES OF ACUSHNET ESTUARY

NEW BEDFORD SUPERFUND PROJECT

INTERIM REPORT

Prepared for:

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New England Division
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June, 1985

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1. INTRODUCTION

The following interim report details the results of late winter/early spring investigations completed for the purpose of evaluating the biological health of wetland resources within the Acushnet River Estuary. The work completed included an ornithological analyses of bird species densities and diversity. The analyses investigated existing bird populations within the estuary and, for comparison, bird populations within a reference site which was presumed to be unpolluted.

In addition, tissue samples were collected from a variety of sources for the purpose of evaluating contaminant levels within trophic levels associated with two food chains. These samples were preserved and Sanford Ecological Services presently is awaiting authorization to conduct appropriate chemical analyses.

This interim report has reserved Sections 2 through 4 for results from a proposed summer study. It is anticipated that the entire study will ultimately deal with vegetation, invertebrates, mammals, birds, and bioaccumulation/bioconcentration of contaminants.

2. VEGETATION

RESERVED

Section anticipated from proposed summer study.

3. INVERTEBRATES

RESERVED

Section anticipated from proposed summer study.

4. MAMMALS

RESERVED

Section anticipated from proposed summer study.

5. ORNITHOLOGY

5.1 INTRODUCTION AND SUMMARY

The task for the late winter/early spring field work in ornithology was to assess the bird species diversity and density in three habitats within the Acushnet Estuary study area. This allowed direct comparison of 1) open water/mudflat, 2) salt marsh and 3) marsh/upland edge avifaunas, and provided an indication of community viability. In addition, a reference site was chosen some distance from the study area. Assuming the reference site to be basically free of, or very low in PCB and heavy metal pollution, a baseline comparison could be made for salt marsh and marsh/upland edge avifaunas. See Figure 5.1 for study site and reference site locations.

The open water/mudflat habitat had few bird species but a comparatively high density. Density declined as spring advanced and many winter residents migrated away to breed elsewhere.

Salt marshes had few species and low densities. Such conditions are typical of partially inundated saline areas.

The marsh/upland edge habitats were rich in species and had high bird densities.

Statistical comparisons of the study site with the reference site showed no significant reduction of bird species or density at the study site salt marsh and edge habitats.

No significant endangered species sightings were noted, although more data are needed on Least Terns, a Massachusetts breeding species of "special concern" observed feeding in the Acushent Estuary in May 1985. Scientific names of all bird species recorded are presented in Appendix I.

5.2 LATE WINTER/EARLY SPRING SAMPLING

Birds can be regarded as extremely efficient indicators, their species diversity and density being a convenient comparative index. Sampling is relatively easy due to their high visibility, ease of identification and mobility. Their wide range of feeding habitats at different upper trophic levels adds to their value as indicators. During the late winter/early spring period (22 February - 19 May 1985) species diversity and density were measured on the study site in open water/mudflat, salt marsh and marsh/upland edge habitats. In addition the Pope Beach reference site (see Figure 5.1) east of South Fairhaven was also sampled for birds to provide a direct (and presumably largely uncontaminated) comparison with the study site on the Acushnet Estuary. No uncontaminated open water/mudflat reference site could be located where physical topography was similar enough to the study site to provide a valid ornithological comparison.

Figure 5.1 Study & Reference Site locations.

5.2.1 Open Water/Mudflat

The Acushnet study area contains approximately 90 hectares (220 acres) of open water/mudflat habitat (NUS, 1984). This includes the estuary from Tarkiln Hill Road Bridge south to the Coggeshall Street Bridge, and then south again to the estuary constriction 1,500 m south of the I-195 Road Bridge. This latter area of deeper water was used as a low-tide roosting area by many waterfowl which were otherwise noted as feeding within the principal study area north of Coggeshall Street Road Bridge. Easy road access to the margins of the estuary made it possible for ornithologists to completely census this habitat during a several hour survey. Surveys were conducted at various tidal stages using binoculars and x 20 telescopes. All birds using this habitat were recorded, but not those flying over it to reach other habitats. "Use" included resting, swimming or feeding on or below the surface of mud or water, and also aerial feeding above this habitat. Table 5.1 presents numbers of each species counted on five dates within the sampling period.

Generally, waterfowl and gull numbers decreased from the high levels recorded in February while shorebirds increased in spring. Numbers of all birds decreased from a high of 849 (377/40 ha or 100 acres) on 22 February to a low of 122 (54/40 ha) on 4 May 1985. Numbers of species recorded remain similar throughout. This is a comparatively high density of water birds for the New England region at this period. Active feeding was noted for most species within the contaminated study area (i.e. this was not merely a roost for birds which fed elsewhere). The February density of 377 birds/40 ha is higher than bird densities recorded in either study of reference sites for the salt marsh and edge habitats.

5.2.2 Salt Marsh

During late winter/early spring, salt marsh had the lowest bird-density of the three habitats observed. Salt marsh also exhibited a low species diveristy, similar to that of the open water/mudflat habitat. Two salt marshes were compared:

1. Acushnet Study Area. Transect SS on Figure 5.1.
2. Reference Site (Pope Beach). Transects RS, RS on Figure 5.1.

In each salt marsh a 1,000 m transect line was established on a compass bearing, the transect being in two sections at the reference site. Between 8-18 April 1985, each transect was surveyed 10 times using the variable-strip census method of J.T. Emlen (1971). Distances to each registration were recorded at 90^{o} to the transect using range finers. For each bird species a detection distance was established, beyond which a greater than 5% drop in detection was noted. These inflection points on the plotted distance curves were then used to determine a species density specific to the habitat, time of year and bird

Table 5.1 OPEN WATER/MUDFLAT BIRD CENSUSES - LATER WINTER/EARLY SPRING 1985

	22 FEB	08 APR	14 APR	04 MAY	19 MAY
Double-crested Cormorant	---	2	1	8	9
Great Egret	---	---	1	---	---
Mute Swan	6	6	4	7	6
Canada Goose	---	2	2	2	2
American Black Duck	24	11	---	---	---
Mallard	22	2	---	---	---
American Wigeon	23	---	4	---	---
Canvasback	4	---	---	---	---
Greater Scaup	10	5	119	---	---
Scaup sp.	140	410	---	---	---
Common Goldeneye	---	---	---	1	---
Bufflehead	14	60	13	2	---
Peregrine Falcon	1	---	---	---	---
Black-bellied Plover	---	---	---	---	2
Killdear	---	---	2	---	---
Greater Yellowlegs	---	2	---	13	6
Spotted Sandpiper	---	---	---	---	1
Laughing Gull	---	---	---	2	---
Common Black-headed Gull	---	1	---	---	---
Ring-billed Gull	266	8	53	36	42
Herring Gull	295	14	11	20	2
Iceland Gull	1	---	---	---	---
Great Black-backed Gull	40	10	16	9	33
Least Tern	---	---	---	8	---
Rock Dove	3	---	---	2	10
Mourning Dove	---	---	---	---	2
Tree Swallow	---	---	---	2	---
American Robin	---	---	---	---	1
European Starling	---	---	7	8	2
Song Sparrow	---	---	---	2	1
Common Grackle	---	---	---	---	8
House Sparrow	---	---	8	---	---
TOTALS #	849	533	241	122	127
SPECIES	13	12	13	15	15

species detectability. When appropriate, territorial song and other sightings were recorded separately to refine the method, see Franzreb (1981). Appendix II presents individual species densities for both salt marsh transects. Records of birds flying over the habitat, but not otherwise using it, were discarded from the analysis. The Mann-Whitney U-test or Wilcoxon two-sample test (Sokal and Rohlf, 1969) were used to test the null hypothesis that the two samples came from populations having the same density distribution. No significant difference was detected between bird species densities in the study and reference marshes (0.2 > P). Thirteen species and a total bird density of 12.2 birds/40 ha were noted within the reference site. Fifteen species and a total bird density of 12.9 birds/40 ha were noted within the reference site. Song Sparrow was the most abundant bird at both salt marshes and 8 species were common to both sites. The salt marsh at the study site thus shows no significant difference in bird populations at this time of year when compared with similar habitat at a presumably unpolluted reference salt marsh.

Species diversity was calculated using the Shannon-Weiner index for both the estuary and reference salt marshes. Species diversity (H) for the study site was 3.158 compared with 3.228 for the reference site. Equitability (E) was 0.854 for the study site compared with 0.826 for the reference site. Both diveristy and equitability measurements suggest highly similar bird communities.

5.2.3 Marsh/Upland Edge

Two examples of marsh/upland edge were compared. Both had significantly higher bird populations than their adjacent salt marshes (approximately 20 times greater). These habitats cover a transition zone from the edge of the salt marsh to adjoining upland or fresh wetland habitats. The transect locations were:

1. Acushnet Study Area. Transect SE on Figure 5.1
2. Reference Site (Pope Beach). Transects RE, RE on Figure 5.1

Methods, timing of field work and analysis were identical to those identified in Section 5.2.2 above on these two 1,000 m transects through edge habitat. Appendices III and IV present individual species densities. No significant difference was detected between bird species densities in the study and reference edge habitats (0.9 > P > 0.5). In this case the study site contained slightly more birds (281.4/40 ha of 28 species) than the reference site 211.6/40 ha of 26 species). A remarkably high 24 of these species were recorded at both sites. Thus the marsh/upland edge at the study site showed no significant difference in bird populations at this time of year when compared with similar habitat at a presumably unpolluted reference edge habitat. The bird densities of either edge habitat were significantly greater (0.002 > P) than that of either salt marsh habitat.

Species diversities were calculated using the Shannon-Weiner index for both the estuary marsh/upland edge community and the reference site edge community. The estuary marsh/upland edge community exhibited a diveristy (H) of 3.906 compared to the reference site edge of 4.156. Equitability (E) was 0.813 for the estuary marsh/upland edge compared to 0.884 for the reference site edge. These data indicate that the marsh/upland edge communities are highly similar.

5.2.4 Endangered Species

The preliminary impact assessment (Sanford Ecological Services, May 1985) notes an immature Peregrine Falcon observed flying over and within the study site on 22 February 1985. The comment that no prior records of this species are known from the area still stands. Its probable migratory status was confirmed by lack of any subsequent records as of 19 May 1985. This was the only state and federal endangered species recorded to date.

A single Sharp-shinned Hawk (22 February 1985) flying over edge and salt marsh habitats, plus eight Least Terns (4 May 1985) fishing in Acushnet Estuary within the study site are worthy of comment. Both species are listed as of "special concern" in the state of Massachusetts Natural Heritage Program, Division of Fisheries and Wildlife. Further study of the status of Least Tern in the estuary is suggested.

6. FOOD CHAINS

6.1 INTRODUCTION AND SUMMARY

The upper Acushnet River estuary is considered highly contaminated with PCBs and heavy metals. It is of importance to determine how readily these hazardous substances are incorporated and concentrated in mammals or birds at or near the top of the food chain. SES (March 1985) proposed to study the following late winter/spring food chains for the Army Corps of Engineers:

mussels - Ring-billed gulls
scavenged marine biota - Norway rats.

After an extensive trapping effort (206 trap nights), only one rat was obtained. Hence the scavenged marine biota - Norway rat food chain was abandoned. The following food chain was substituted:

arthropods, nuts, fruits - White-footed mice.

White-footed mice provide a similar attraction as the rat in that a mammal food chain is included in the evaluation. In addition mice are potential prey for cats and dogs and hence an indication as to whether contaminants can reach house pets may be obtained.

All organisms collected will be analyzed for contaminants when authorization is received by SES. A minimum of 0.5 g wet weight of tissue is needed for PCB analysis. Small organisms collected were pooled in order to achieve a sufficient tissue weight for analysis. All specimens were stored in glass that was washed with soapy water and rinsed three times with distilled water, and then frozen.

6.2 Mussel - Ring-billed Gull

To determine the bioaccumulation of PCBs in the mussel - Ring-billed gull food chain, 20 ribbed mussels (Geukensia demissa) were collected on 4/19 from each of five stations (1-4A) on the eastern shoreline of the upper Acushnet River estuary (Figure 6.1). All mussels were collected at random locations along a 15 m transect located 1-2 m below the seaward limit of salt marsh cordgrass (Spartina alterniflora) colonization, and placed in quart glass jars. These specimens were transported back to the lab on ice and one half were immediately frozen for any analyses needed in the future (e.g., histological). On the remaining mussels whole wet weight, shell weight, meat wet weight and length were measured. Shells were scrubbed clean of any debris before weighing. Shell length was measured with a craftsman (0.05 mm) caliper, and meats were placed on filter paper for 2 minutes before weighing. A total of 50 mussels were measured. Within each station the meats of five mussels were pooled to form two replicate samples for analysis from each of the 5 stations. Ring-billed gulls also feed on amphipods. The amphipod (Orchestia grillus) is very abundant in the upper Acushnet River estuary. Orchestia were collected at stations 1-5 (Figure 6.1) primarily under algal mats or wrack in the low marsh. An average of 36 Orchestia were collected at each station and stored on ice in glass vials.

Ten Ring-billed Gulls were collected by Manomet Bird Observatory on 15 April 1985. State and federal collecting permits were obtained in advance of this work and the use of a shotgun was cleared with the police departments of Acushnet, Fairhaven and New Bedford. Due to the timing of the work, this late migrating winter species was present in reasonable numbers at a time when most of the ducks had left the study area on spring migration. Ring-billed Gulls exhibit strong site tenacity and seldom if ever, feed at nearby sanitary landfills as do Herring and Great Black-backed Gulls. Thus the likelihood of injection of PCBs from sources other than the food chains in the study area was minimized. Specimens were chilled on ice until breast muscle and subcutaneous fat samples could be taken in the lab. These samples were stored in sterile glass containers and frozen pending later analysis. The birds were sexed, measured, weighed and frozen; and the guts preserved in 40% formaldehyde for future analysis. Chain of custody and log sheet records were completed and all specimens are preserved pending authorization for further work by NED. The results will be presented in a subsequent report.

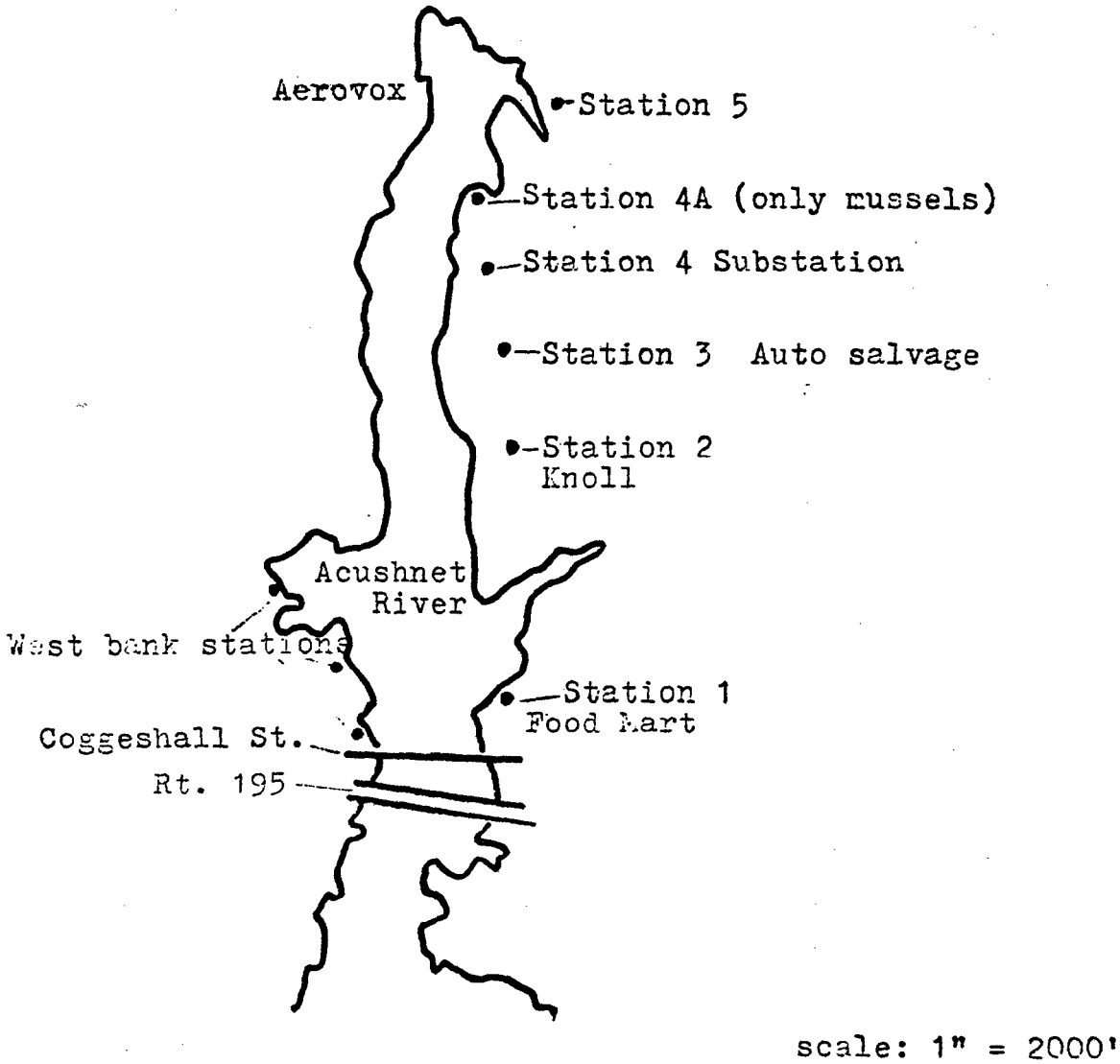

Figure 6.1 Collection Stations in Hot Spot Area - Upper Acushnet River Estuary, MA

6.3 Arthropods, Seeds, Nuts - White-footed Mice

The collection of White-footed mouse (Peromyscus leucopus) food was concentrated at the upland-marsh border where the mice were trapped. On April 29, 1985 at stations 2 and 4, seeds of the salt marsh grasses (Distichlis spicata and Spartina alterniflora), bayberry fruits, insects (Orthoptera, Hemiptera, Coleoptera), isopods, millipedes, acorns, horse-briar fruits, rose fruits, and black grass shoots (Juncus gerardii) were collected and stored on ice in 2 oz glass jars. The number of specimens in each sample were counted (excepting grass seeds and bayberry fruits), sample wet weight was measured and the samples frozen.

On April 19 and 20, 1985 two-hundred and six snap-traps were randomly laid out primarily on the east side of the Acushnet River estuary in stations 1-5 along the salt marsh upland border of grass shrubs. See Table 6.1 for more detail. One-hundred and fifty-two traps were baited with a mixture of oatmeal and peanut butter and fifty with beef hotdogs. Traps were checked the following day and captured mice were placed in 4 oz glass jars. The mice were transported back to the lab on ice, sexed and their whole body weight recorded. One female mouse from station 4 was dissected to determine if sufficient adipose tissue were present in an individual mouse for PCB analysis. The adipose wet weight was only 0.2 g, an insufficient amount for PCB analysis. Therefore, whole animals were frozen for later homogenization.

6.4 RESULTS AND DISCUSSION

RESERVED

Section anticipated from proposed summer study.

Table 6.1 Trapping Information 19, 20 April 1985

Stations (East Side)	Trap NO.	Animals Caught	Habitat
1	80 Peanut Butter Oatmeal	3 House Mice (*Mus musculus*)	Salt Marsh - Upland Border
	30 Beef Hotdog	1 Norway rat (*Rattus norvegicus*)	Garbage bottom of rubble adjacent to Food Mart parking lot.
2	24 Peanut Butter Oatmeal	3 White-footed Mice (*Peromyscus leucopus*)	Upland-marsh border with little blue stem sumac, marsh elder
3	24 Peanut Butter Oatmeal	4 White-footed Mice	Upland-marsh border upland grass sparse shrubs above auto salvage.
4	24 Peanut Butter Oatmeal	7 White-footed mice	Marsh elder, salt marsh grass
5	24 Peanut Butter Oatmeal	1 White-footed mouse	Marsh elder and salt marsh grass- on marsh about 15 m from upland
(West Side)			
	24 Hotdog Beef	0	Upland grass and shrub near factories, rubbish

Total trap nights = 206 trapping success for small mammals = 19/206 = 9.2%

7. SUMMARY AND CONCLUSIONS

RESERVED

Section anticipated from proposed summer study.

8. REFERENCES

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APPENDIX I. SCIENTIFIC NAMES OF BIRD SPECIES RECORDED DURING LATE WINTER/ EARLY SPRING STUDIES

Double-crested Cormorant	Phalacrocorax auritus
Great Blue Heron	Ardea herodias
Great Egret	Casmerodius albus
Mute Swan	Cygnus olor
Canada Goose	Branta canadensis
American Black Duck	Anas rubripes
Mallard	A. platyrhynchos
American Wigeon	A. americana
Canvasback	Aythya valisineria
Greater Scaup	A. marila
Scaup sp.	A. sp.
Common Goldeneye	Bucephala clangula
Bufflehead	B. albeola
American Kestrel	Falco sparverius
Peregrine Falcon	F. peregrinus
Black-bellied Plover	Pluvialis squatarola
Killdeer	Charadrius vociferus
Greater Yellowlegs	Tringa melanoleuca
Spotted Sandpiper	Actitis macularia
Laughing Gull	Larus atricilla
Common Black-headed Gull	L. ridibundus
Ring-billed Gull	L. delawarensis
Herring Gull	L. argentatus
Iceland Gull	Larus glaucoides
Great Black-backed Gull	L. marinus
Least Tern	Sterna antillarum
Rock Dove	Colomba livia
Mourning Dove	Zenaida macroura
Downy Woodpecker	Picoides pubescens
Hairy Woodpecker	P. villosus
Northern Flicker	Colaptes auratus
Tree Swallow	Tachycineta bicolor
Blue Jay	Cyanocitta cristata

Appendix I (continued)

American Crow	Corvus brachyrhynchos
Black-capped Chickadee	Parus atricapillus
Tufted Titmouse	P. bicolor
Carolina Wren	Thryothorus ludovicianus
American Robin	Turdus migratorius
Gray Catbird	Dumetella carolinensis
Northern Mockingbird	Mimus polyglottos
European Starling	Sturnus vulgaris
Yellow-rumped Warbler	Dendroica coronata
Northern Cardinal	Cardinalis cardinalis
American Tree Sparrow	Spizella arborea
Field Sparrow	S. pusilla
Savannah Sparrow	Passerculus sandwichensis
Song Sparrow	Melospiza melodia
Swamp Sparrow	M. georgiana
White-throated Sparrow	Zonotrichia albicollis
Red-winged Blackbird	Agelaius phoeniceus
Eastern Meadowlark	Sturnella magna
Common Grackle	Quiscalus quiscula
Brown-headed Cowbird	Molothrus ater
House Finch	Carpodacus mexicanus
American Goldfinch	Carduelis tristis
House Sparrow	Passer domesticus

APPENDIX II. SALTMARSH BIRD DENSITIES (#/40 ha) RECORDED DURING LATE WINTER/ EARLY SPRING TRANSECTS

Acushnet Study Area		Reference Site	
American Black Duck	1.4	Great Blue Heron	0.5
American Kestrel	0.3	American Black Duck	0.4
Killdeer	0.6	Mallard	0.5
Greater Yellowlegs	0.9	American Kestrel	1.1
Mourning Dove	0.3	Killdeer	1.4
Tree Swallow	0.3	Greater Yellowlegs	0.4
American Crow	1.7	Ring-billed Gull	0.2
American Robin	0.6	Herring Gull	1.4
Savannah Sparrow	0.6	Great Black-backed Gull	0.2
Song Sparrow	4.0	Mourning Dove	0.2
Sparrow sp.	0.3	American Crow	1.3
Common Grackle	0.6	Northern Mockingbird	0.2
Eastern Meadowlark	0.6	Savannah Sparrow	0.4
		Song Sparrow	4.3
		Sparrow sp.	0.4
TOTAL: 13 species	12.2/40 ha	TOTAL: 15 species	12.9/40 ha

APPENDIX III. MARSH/UPLAND EDGE BIRD DENSITIES (#/40 ha) RECORDED DURING LATE WINTER/EARLY SPRING TRANSECTS

1. Acushnet Study Area

American Kestrel	0.4	Yellow-rumped Warbler	10.5
Rock Dove	4.9	Northern Cardinal	6.5
Mourning Dove	2.0	American Tree Sparrow	3.2
Downy Woodpecker	0.8	Field Sparrow	3.6
Hairy Woodpecker	0.6	Savannah Sparrow	0.7
Northern Flicker	3.4	Song Sparrow	35.9
Blue Jay	12.8	Swamp Sparrow	1.4
American Crow	2.9	White-throated Sparrow	14.5
Black-capped Chickadee	1.0	Red-winged Blackbird	13.1
Tufted Titmouse	2.9	Common Grackle	40.8
Carolina Wren	6.2	Brown-headed Cowbird	3.3
American Robin	33.1	House Finch	5.2
Northern Mockingbird	17.6	American Goldfinch	4.1
European Starling	44.6	House Sparrow	5.4

TOTAL: 28 species 281.4/40 ha

APPENDIX IV. MARSH/UPLAND EDGE BIRD DENSITIES (#/40 ha) RECORDED DURING LATE WINTER/EARLY SPRING TRANSECTS

2. Reference Site

Rock Dove	0.2	Yellow-rumped Warbler	18.6
Downy Woodpecker	4.7	Northern Cardinal	7.5
Northern Flicker	6.4	Field Sparrow	0.6
Tree Swallow	0.9	Savannah Sparrow	0.7
Blue Jay	1.0	Song Sparrow	27.8
American Crow	6.8	Swamp Sparrow	2.1
Black-capped Chickadee	11.0	White-throated Sparrow	13.1
Tufted Titmouse	9.2	Red-winged Blackbird	6.5
Carolina Wren	4.1	Common Grackle	5.1
American Robin	15.9	Brown-headed Cowbird	5.3
Gray Catbird	7.3	House Finch	13.1
Northern Mockingbird	4.1	American Goldfinch	23.1
European Starling	15.1	House Sparrow	1.4

TOTAL: 26 species 211.6/40 ha